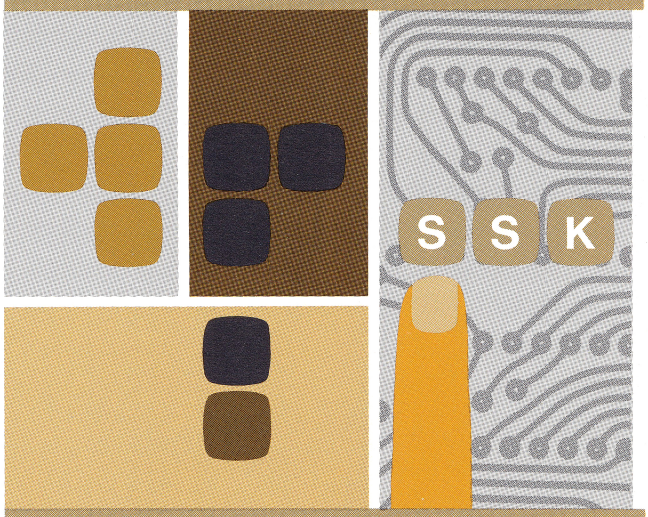
MICRO SWITCH

Condensed Keyboard Guide



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INTRODUCTION

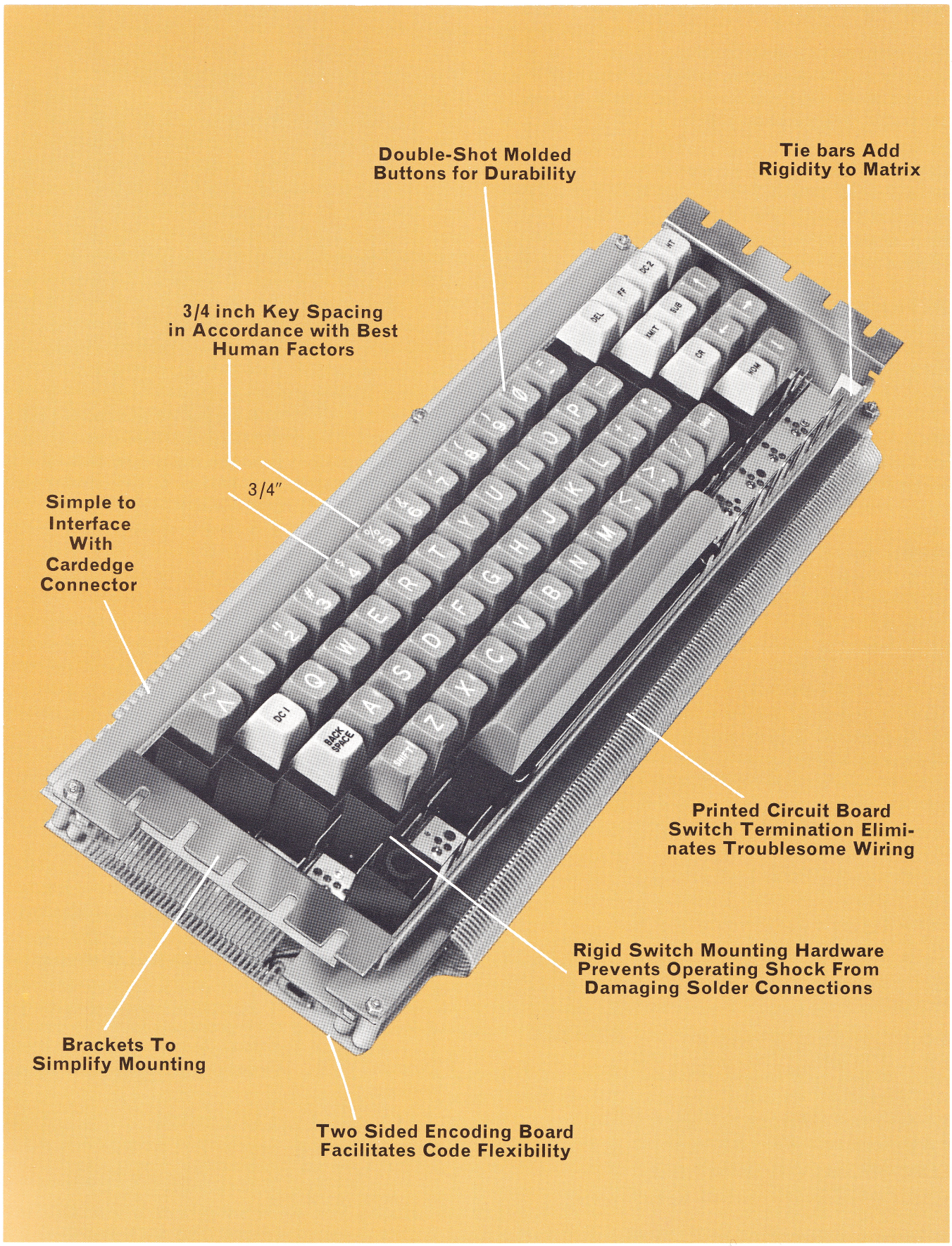
In response to the low cost, high reliability keyboard needs of the rapidly growing computer and related industries . . . MICRO SWITCH has developed a revolutionary concept . . . completely assembled wired and encoded all solid state keyboards. The projected growth in peripheral equipment — including remote terminals, input devices, and others — has made the cost of keyboards an increasingly more significant factor.

Based on the concept of triggering integrated circuits with plunger mounted magnets, the solid state keyboard projects cost savings to its users . . . through low initial investment and maintenance-free operation. Reliability is inherent in its design by the elimination of mechanical linkages and electromechanical parts.

The flexibility of this keyboard will soon parallel that which is already available with our reed switch keyboards. This will include options to meet customer needs through standard keyboard hardware and electronic circuits.

This guide briefly describes our product and options to give you an idea of the broad offering that we already have available. Call your nearest MICRO SWITCH branch office and a trained Field Engineer will provide more information and literature describing each feature and option in detail. The address and phone number are listed on the back cover.

TYPICAL SOLID STATE KEYBOARD



PRODUCT DESCRIPTION

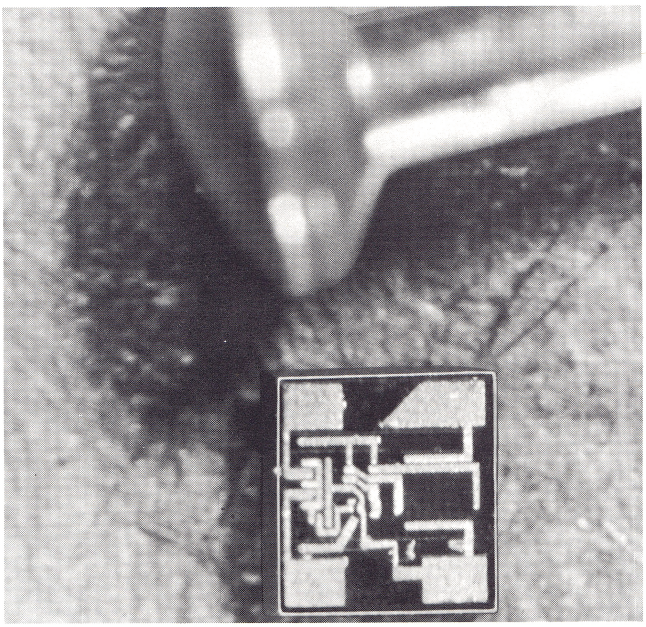
SWITCHING CONCEPTS

We investigated several techniques, such as mechanical and photoelectric switching, however, they did not meet our objectives for reliability, maintainability, life, flexibility and cost.

In 1966, we introduced our hermetically sealed reed switch key module which met most of the above requirements. However, we have now made a technological breakthrough in the switching art with our solid state switch module. This switch gives unequaled reliability at lower cost.

SOLID STATE SWITCH

The switching element is an integrated circuit only 0.040 inch square. This circuit has a Hall generator which is activated by a magnet to produce an analog control voltage. The Hall voltage is converted into a digital output through the use of a trigger circuit. The trigger output is amplified and fed into the encoding matrix of our keyboards.



Enlarged photo of chip circuit shown next to the head of a common pin.

The solid state chip is assembled into a rugged switch module. The button plunger assembly is the only moving part in our keyboard. Thus, to make sure it meets quality objectives, we have made it from extremely durable plastic with a large bearing surface for exceptionally long operating life.

The top portion of the plunger accepts MICRO SWITCH double-shot buttons, without requiring adapter pins. This provides a strong plunger-to-button mount with a low profile. The plunger is keyed into the switch housing to assure button alignment.

A magnetic shunt member containing two very stable barium ferrite filled PVC magnets, is attached to the switch plunger. When the key is operated, the magnetic field through the Hall element increases, raising Hall voltage to the operating level of the trigger circuit.

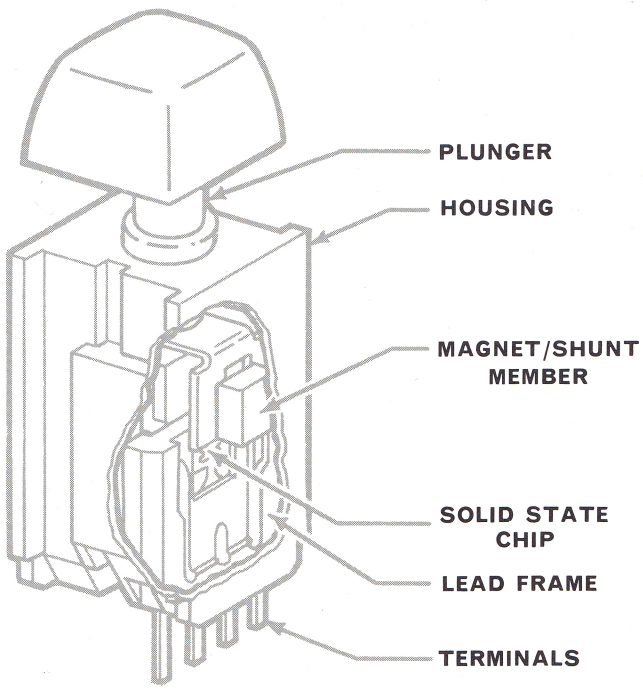
The solid state switch provides unequalled reliability at a cost never before possible. Some of the advantages are:

NO MOVING CONTACTS

- No bounce, thus eliminating: Bounce gates — Delay circuits
- Exceptionally long life • High reliability
- Not a source of RFI

ELECTRICALLY COMPATIBLE

- Your entire system can now be solid state.



- Outputs easily interfaced with standard logic systems.

ELECTRICAL REPEATABILITY

- No degradation due to life.
- Circuits do not have to compensate for variations in contact resistance.

PRODUCT DESCRIPTION

SWITCH SPECIFICATIONS

Power Requirements	5 Volts DC Regulated ±5%
Current Drain	Standby: 15 MA maximum per switch. (12MA typical) Operated: Typical 2 MA in addition to standby with our encoding.
Output Capacity	Quiescent State: 100 microamps leakage maximum. Operated: 3.15 volts minimum @ 1 to 10 MA current source. NOTE: These are the levels that are available if you chose to do your own encoding. (On "wired only" keyboards the two outputs per switch are paralleled and extended to the top edge of the termination circuit board.)

OPERATING CHARACTERISTICS

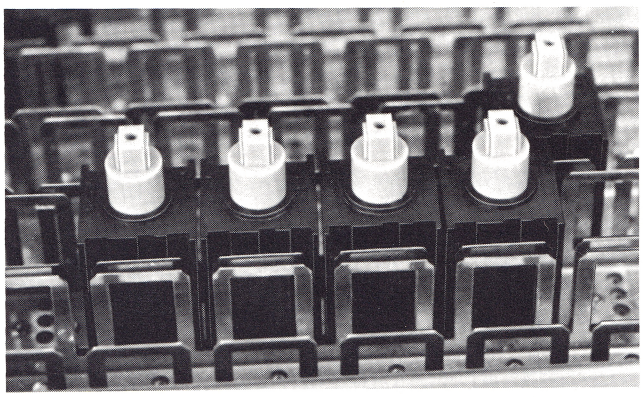
The operating characteristics of our keyboards are similar to those found on the highest quality office typewriters. We have followed this precedent to minimize operator training requirements.

Force at Operating Point	3 oz. Nominal (Approx. 85 grams)
Pretravel	0.125 inch (+0.025 —0.050)
Total Travel	0.187 inch nominal
Release Point	0.040 inch minimum from free position

NOTE: These specifications do not apply to the alternate action switch module.

SWITCH MOUNTING

A rigid mechanical mounting frame supports switch modules to eliminate stress on printed circuit boards and solder connections. The possibility of failure as the result of solder cracks is virtually eliminated.



Switch Module Mounting

ABOVE PANEL KEYBOARD FEATURES

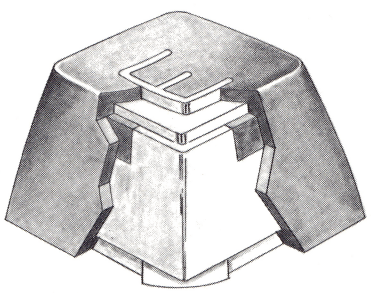
This is the area that is of greatest concern in terms of operator efficiency and the appearance of the keyboard with your equipment.

An extensive Human Factors study was made to determine the optimum design. This included the retaining of nationally recognized human factors experts and a review of all published literature.

BUTTONS

The button style was selected after an extensive study of industrial design aspects, human factors, durability, and legending techniques. Our button complements both highly stylized and purely functional appearances.

The durability of the legend is assured because of the double-shot molding technique used.



The legend is a molded integral part of button.

PRODUCT DESCRIPTION

BUTTONS (cont.)

A wide variety of standard button colors are available to suit individual requirements. For special functions we offer several button sizes including: one-unit, two-unit, two-unit two-level, three-unit, and eight-unit space bars.

LEGENDS

For easy recognition, Modified Gorton Normal style legends are used. We have more than 250 legends and are continually tooling additional ones. If tooling is not available for the legends you desire, we will set them up upon the receipt of your order at a nominal charge.

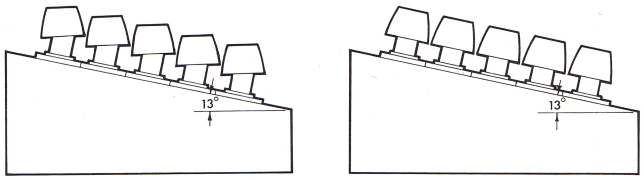
KEY SPACING

In accordance with the conclusions of human factors research, our keys are spaced 3/4-inch center-to-center. This is the same spacing as found on standard office typewriters.

KEYROW OFFSET

We offer the standard typewriter offset of 3/8—3/16—3/8-inch and the keypunch offset of 3/8—3/8—3/8-inch will soon be available.

KEY TOP ORIENTATION

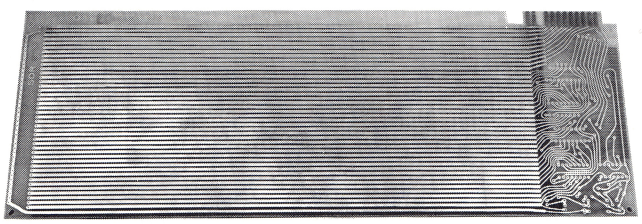


Stepped Sloped

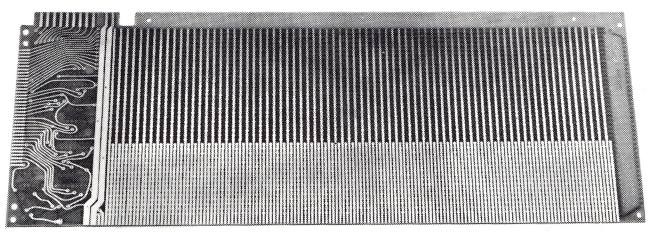
We offer both stepped and sloped key arrangements to meet your preference. Human factors studies indicate that both arrangements provide equal comfort and speed.

ENCODING

Our encoding technique offers flexibility to assign any code up to eight bits. Solid state encoding in combination with extremely reliable switches assures trouble-free operation.



Row Side of Encoding Board.



Column side of Encoding Board.

Two isolated outputs per switch are extended to the two-sided encoding printed circuit board. Selected interconnections are made between columns on one side of the board, with rows on the opposite side extending the switch outputs to integrated circuit encoding packs. There are two groups of 16 rows. Within each group, all code combinations from 0000 to 1111 are represented. Each row within a group represents a distinct combination of a four-bit code. Thus, the two switch outputs of each switch energize two separate encoding packs. In this manner a total of eight bits per key may be generated. The code that a given key generates is determined by the interconnections made on the two-sided encoding board. When customer code requirements are received, a production template is made to ensure that the interconnections are drilled to correspond with the desired code.

Another advantage of our encoding technique is that it lends itself to the cost saving possibilities of logical bit pairing of the USASCII code structure for dual mode operation. This is because with proper pairing of characters, the same code is generated for both modes and a single bit is inverted to achieve shift. Your MICRO SWITCH Field Engineer will help to work out the details. The USASCII Code chart shown below will provide some guide lines on the logical pairing of characters.

b_7 b_6 b_5 →	0 0 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
Bits b_4 b_3 b_2 b_1 ↓ / Column → / Row ↓	0	1	2	3	4	5	6	7
0 0 0 0	0	NUL	DLE	SP	0	@	P	\	p
0 0 0 1	1	SOH	DC1	!	1	A	Q	a	q
0 0 1 0	2	STX	DC2	"	2	B	R	b	r
0 0 1 1	3	ETX	DC3	#	3	C	S	c	s
0 1 0 0	4	EOT	DC4	$	4	D	T	d	t
0 1 0 1	5	ENQ	NAK	%	5	E	U	e	u
0 1 1 0	6	ACK	SYN	&	6	F	V	f	v
0 1 1 1	7	BEL	ETB	'	7	G	W	g	w
1 0 0 0	8	BS	CAN	(	8	H	X	h	x
1 0 0 1	9	HT	EM	)	9	I	Y	i	y
1 0 1 0	10	LF	SUB	*	:	J	Z	j	z
1 0 1 1	11	VT	ESC	+	;	K	[	k	{
1 1 0 0	12	FF	FS	,	<	L	\	l	|
1 1 0 1	13	CR	GS	-	=	M	]	m	}
1 1 1 0	14	SO	RS	.	>	N	^	n	~
1 1 1 1	15	SI	US	/	?	O	_	o	DEL

Unshifted Shifted Control (Function)

INTERFACE OUTPUTS

Our standard offering is negative logic. (The term "negative logic" means that logic "1" is closer to zero volts than logic "0".) Logic is current sinking, thus it is compatible with DTL and TTL system logic. And, with the addition of resistors at the output, it is also compatible with RTL system logic.

Logic Levels	Logic "0" = Greater than 2.6 VDC @ 0.12 MA Logic "1" = Less than 0.45 VDC @ 12 MA
Function Outputs	Unoperated: 0.25 volts DC maximum with load resistance of 2500 ohms or less. Operated: 3.15 volts minimum @ 1 to 10 MA current source.

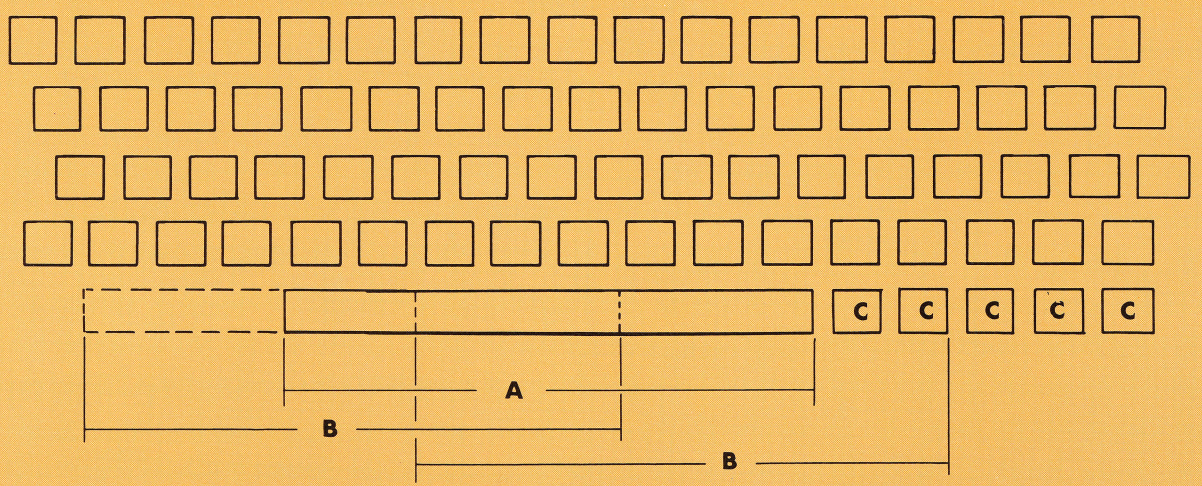
NOTE: The logic levels are the same for mono and dual mode keyboards.

FORMAT VARIATIONS

Our standard keyboard hardware allows considerable flexibility in assigning keys. The two basic formats are 14 stations per row and 17 stations per row. Each offers a great deal of latitude with regard to the number of stations and key locations, as outlined below.

BASIC 17 STATIONS PER ROW FORMAT

KEYROW OFFSET 3/8 — 3/16 — 3/8 (Up to 69 keys including space bar)



A. Normal location of spacebar.

B. Extreme optional positions of space bar. It can be moved in increments of 0.750 inch.

C. Up to 5 function or encoded keys can be placed to right of space bar.

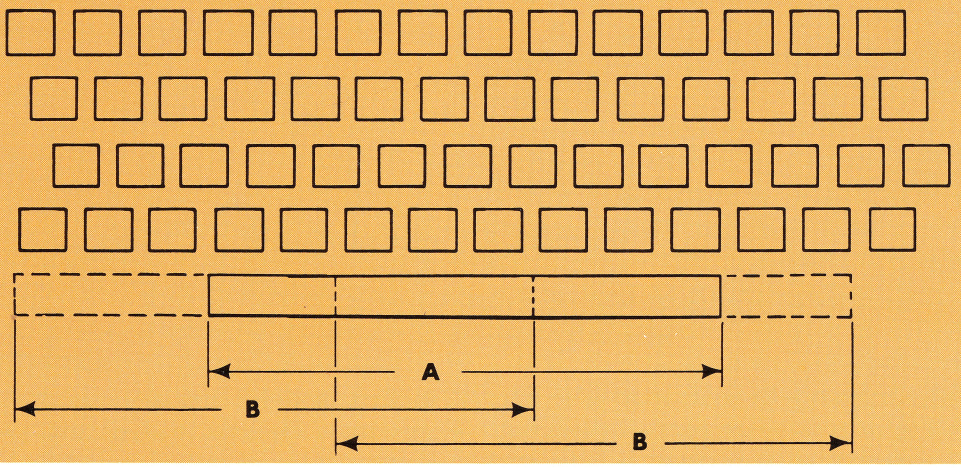
NOTES:

1. Up to 10 function keys including shift may be located anywhere in the format (one function line is required for shift on dual mode keyboards).
2. Function or numeric clusters may be set apart from the touch typing area by the elimination of one switch in each row.
3. Switch stations that are not needed will be eliminated as requested.

FORMAT VARIATIONS

BASIC 14 STATIONS PER ROW FORMAT

KEYROW OFFSET 3/8 — 3/16 — 3/8 (Up to 57 keys including space bar)



A. Normal location of spacebar.

B. Extreme optional positions.

C. Up to 10 function keys including shift may be located anywhere in the format (one function line is required for shift on dual mode keyboards).

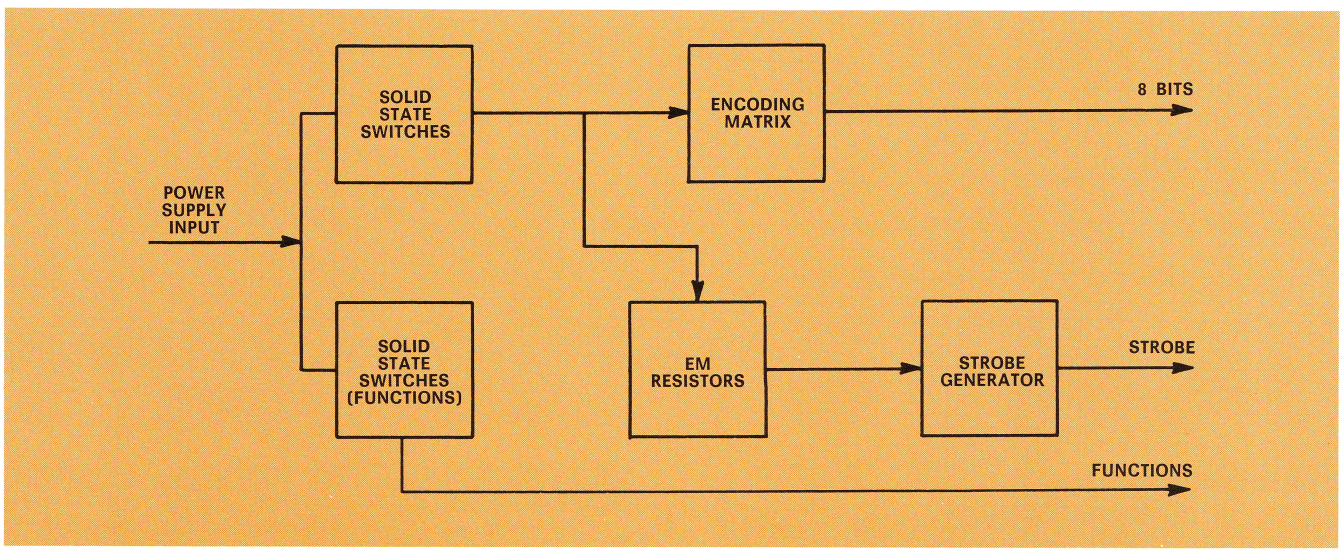
NOTE: Switch stations that are not needed will be eliminated as requested.

OPTIONS

To meet the requirements of various systems, we offer a variety of options. The design of each option has taken into account system requirements, human factors, reliability, and cost. You need only select those options that are necessary for your application, thus, keeping cost down.

STROBE

The strobe signal may be used to trigger circuitry in a system, to read the encoded output of the keyboard. It is not necessary to delay the signal since our solid state switches have a bounce-free output.



STROBE OUTPUT LEVELS (To drive one DTL logic input)

All Keys in Unoperated State	2.6 volts DC minimum @ 0.12 MA
One Key Operated	0.45 volts DC maximum @ 12 MA
Two-Key Roll over Condition	2.6 volts DC minimum @ 0.12 MA

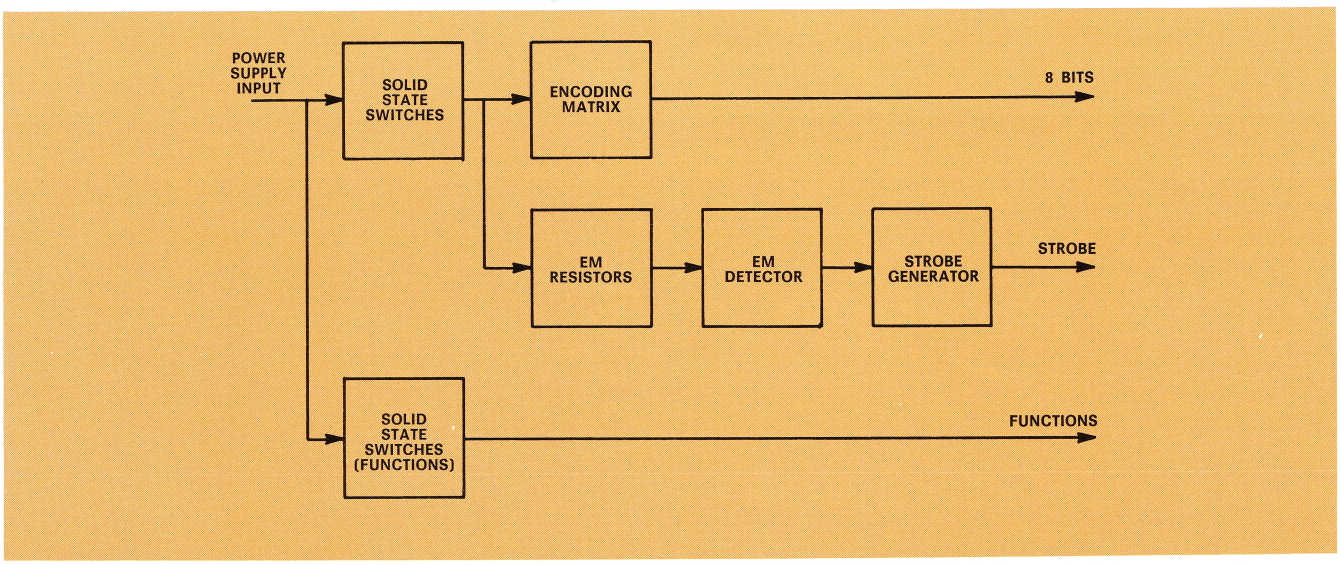
TWO-KEY ROLLOVER (Electronic Interlock)

Two-key rollover prevents the entry of erroneous codes as the result of "burst speed" typing of familiar words such as "and" and "the." A second key is often depressed before the first key is fully released. Unless provision is made for this condition two characters would be superimposed and enter erroneous information into the system. This option allows the operator to type at her maximum rate without generating an erroneous code or error indication.

This is accomplished with circuitry that blocks strobe output during a two-key-down situation, in the following manner:

- In the unoperated state, strobe is "high" due to the absence of electrical monitor voltage.
- First key operated: An electrical monitor voltage appears causing strobe to go "low" allowing the system to read the presented data bits.
- Second key is depressed before first key is released: This two key down condition is detected and causes strobe to go "high". This can be used to block the system from reading erroneous data produced from the two key operated condition.
- First Key Released: Now only the second key is down, thus this one-key down condition permits strobe to go "low" and the encoded output of the second key can be read by the system.

In this manner no data is lost, yet the operator is never inhibited by the interlock, as is the case with mechanical interlocking devices.



SHIFT LOCK

This option is offered for dual mode applications that require extensive typing in the shifted mode, such as keyboards encoded for upper and lower case alpha.

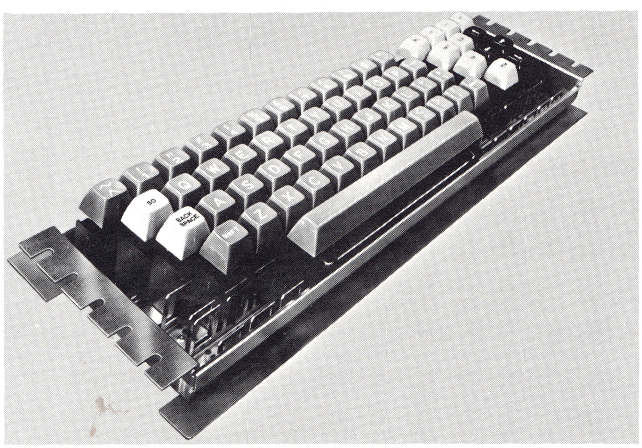
A two level alternate action key is used to maintain the shift circuit within the keyboard. When the shiftlock key is operated it remains visibly below (approx. 3/16 inch) the level of the other unoperated keys which tells the operator that the keyboard is in the shifted mode. The keyboard remains in the shifted mode until the shiftlock key is operated a second time. The key then returns to the normal height of the rest of the keys and the shift circuit returns to the unshifted mode.

"WIRED ONLY" KEYBOARDS

If you wish to do the encoding within your system, MICRO SWITCH will furnish keyboards with switches terminated to a printed circuit board. The isolated switch outputs are extended to the top edge of the circuit board with accomodations for connecting wires. There is one isolated output per switch.

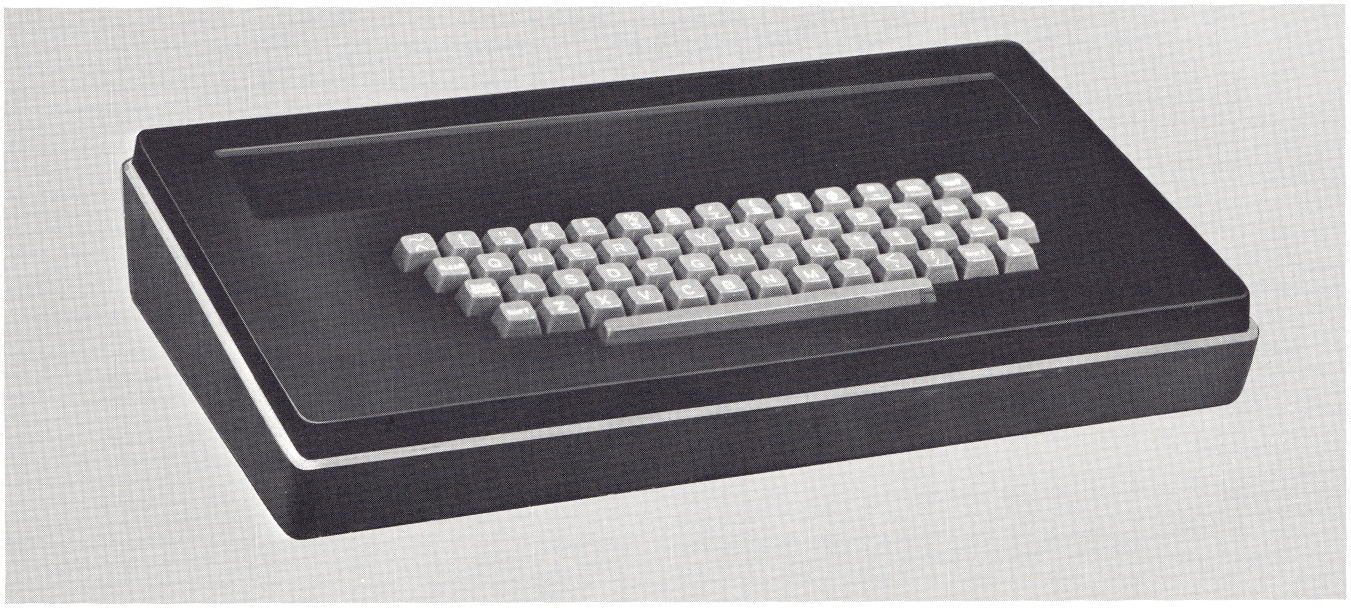
A "wired only" keyboard will include:

- Switches (with or without buttons).
- Termination Board with all switch terminals soldered in place.
- All mounting hardware.



Typical "Wired Only" Keyboard

ENCLOSURE



A modern desktop enclosure is offered to fill requirements for low volume applications and prototype evaluation. The cover is high strength ABS (Acrylonitrile-Butadiene-Styrene) and the base is cast aluminum alloy. The cover has a matte finish in dark gray and the base is light gray. Other colors can also be provided.

CUSTOMER SERVICES

Factory-trained Field Engineers are available to help determine your requirements and transform them into a Customer Specification Sheet. They are in an ideal position to give sound advice and suggest cost-saving possibilities in the selection of option and features. We invite you to consult your nearest MICRO SWITCH branch office today for complete details on how our keyboards can meet your specific needs.

Upon acknowledgement of your order we will provide the following information:

- Mounting dimension drawings, including panel cutout information.
- Code assignments referenced to a drawing of the keyboard format.
- An identification drawing of the interface pads.
- Electrical data and logic levels.

This information will also accompany each keyboard shipment.

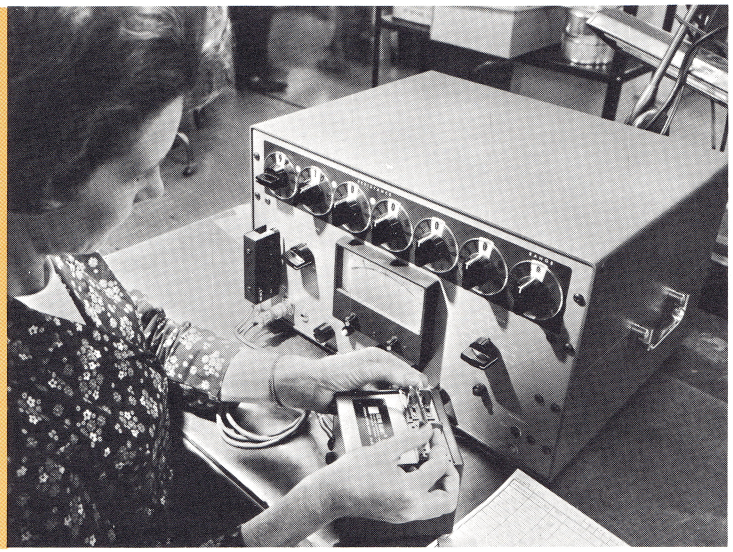
QUALITY ASSURANCE

A total Quality Assurance program follows the keyboards through every production phase. This program begins at the design concept with Quality Assurance Engineers working in conjunction with Design Engineers. A complete quality plan is established which insures that quality is not inspected into our keyboards, but built in. "We're a little more careful — to make you a little more sure."

INCOMING INSPECTION

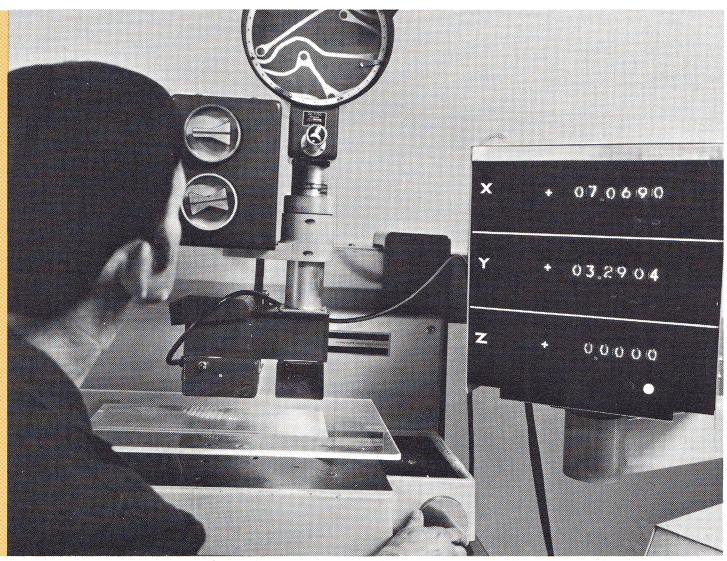
Purchased parts are thoroughly checked before they are released to production.

Electronic components are inspected in accordance with accepted practices of the industry.



Printed circuit boards are inspected for all possible visual defects.

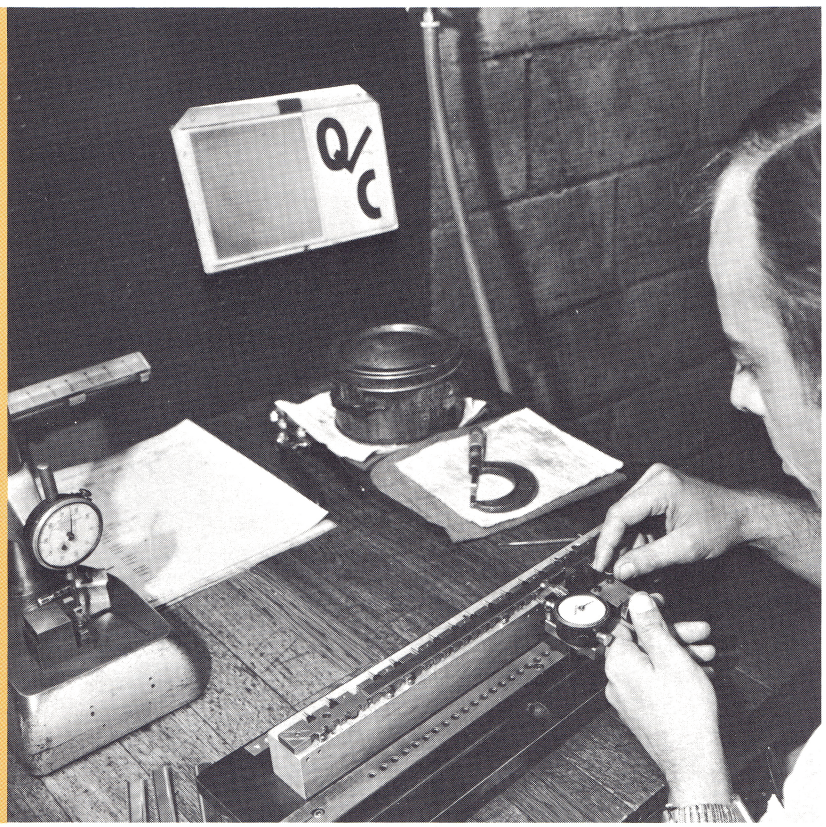
In addition, printed circuit board inspection includes checking of dimensions, hole sizes and locations, and registration of terminal areas and conductor paths. Highly accurate equipment, such as this triple-axis coordinated measuring machine is used.

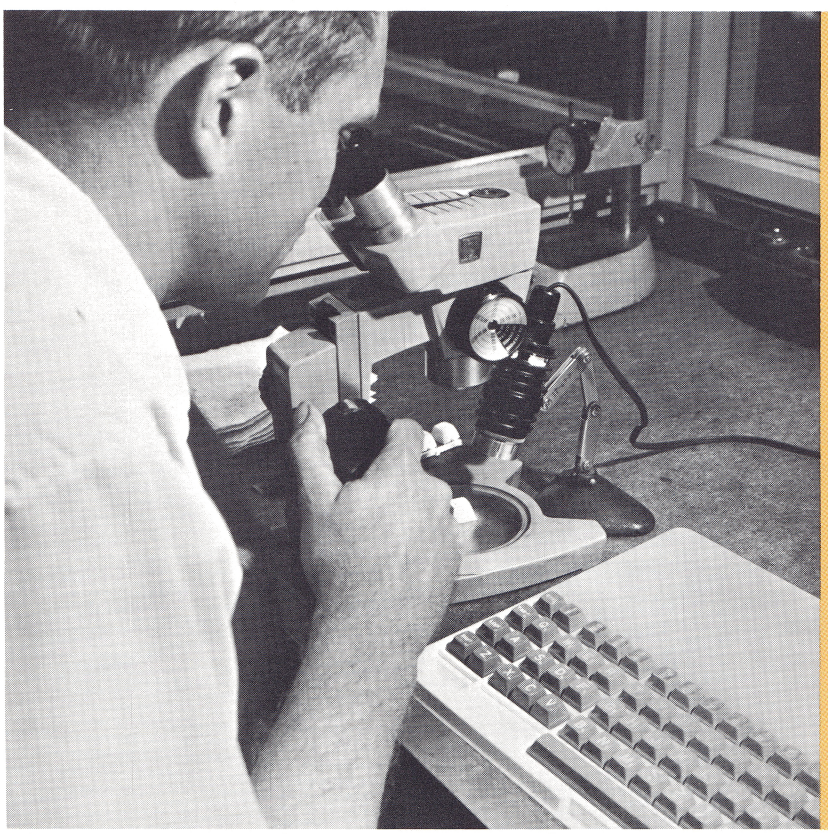


QUALITY CONTROL OF IN-HOUSE COMPONENT PRODUCTION

Components manufactured by MICRO SWITCH must meet all design specifications for size, appearance, and functionability. The following illustrations depict typical quality procedures.

Parts manufactured in our punch press department are checked for proper dimensions and appearance. Here switch mounting rails are inspected by quality control personnel.



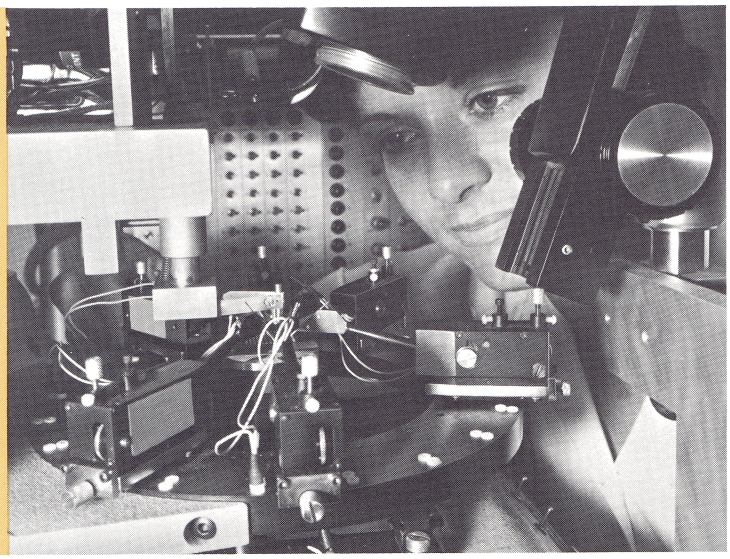


Plastic parts are inspected at the production area. Double-shot molded buttons are checked for voids and knit lines. Legends are examined for legibility, size, location on the button, and stroke width.

SOLID STATE SWITCH QUALITY CONTROL

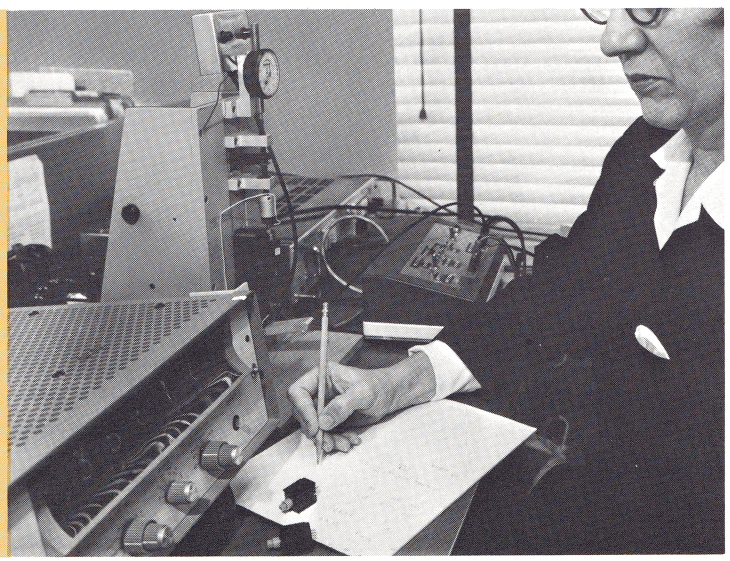
The inspection of the solid state switch covers every aspect of the total module.

The electrical characteristics of every integrated chip circuit are measured before mounting in the switch module.



The chip metalization is visually inspected as well as the edges where they have been *sawed* from the manufactured wafer.

The assembled solid state module is completely checked for both electrical and operating characteristics.



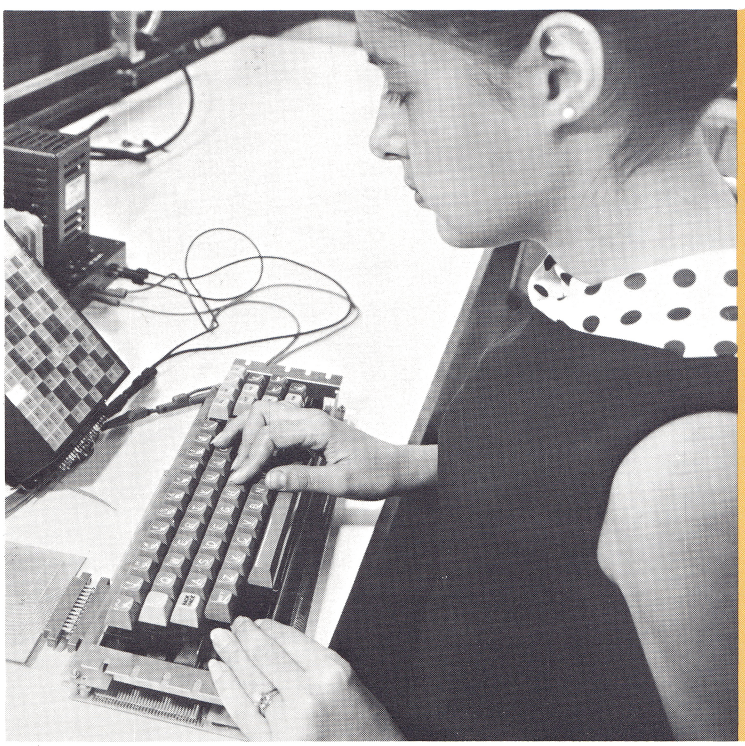
IN-PROCESS ASSEMBLY INSPECTIONS

During keyboard assembly, inspection sequences are made in the production cycle at all logical subassembly stages to insure that no quality requirement is overlooked.

An example of the in-process inspection procedure is the visual inspection of printed circuit boards for any possible damage as the result of handling.

FINAL INSPECTION

A comprehensive final inspection is conducted for both functional and visual defects on the assembled keyboard.



One of the final inspection procedures is a complete decoding of the keyboard to insure that the encoding meets customer specifications.

THIS THOROUGH QUALITY ASSURANCE PROGRAM MEANS TROUBLE-FREE PERFORMANCE. IT ALSO MEANS THAT YOU WILL RECEIVE KEYBOARDS CONSISTENT WITH YOUR REQUIREMENTS. IN YOUR SYSTEM IT RESULTS IN TOTAL RELIABILITY.

MICRO SWITCH Field Engineers are pleased to offer you practical solutions to your keyboards needs. Contact your nearest Branch Office.

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Detroit, Michigan 48227
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Hartford, Connecticut 06101
885 Wethersfield Avenue
203/527-0178

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8440 Westglen Drive
713/785-3200

Indianapolis, Indiana 46241
5739 Professional Circle
317/243-0831

Kansas City, Missouri 64130
4650 East 50 Highway
816/923-2582

Long Island City, New York 11101
24-30 Skillman Avenue
212/786-5005

Los Angeles, California 90022
6620 Telegraph Road
213/723-6611

Milwaukee, Wisconsin 53222
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